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AUTHOR Steinberg, Esther R.
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ABSTRACT

Color monitors are in wide use in computer systems. Thus, it is important to understand how to apply color effectively in computer assisted instruction (CAI) and computer based training (CBT). Color can enhance learning, but it does not automatically do so. Indiscriminate application of color can mislead a student and thereby even interfere with learning. Research is equivocal about the effectiveness of color in instruction, and the application of color in instructional materials is still more of an art than a science. Nevertheless, there is some knowledge from research and practical experience for guidance. For example, color enhances learning by motivating students, attracting attention, emphasizing important elements, locating information, adding structure, supporting memory and recall, differentiating among elements, tying together related items, and adding visual cues. Variables that interact with color include the characteristics of the learner, the nature of the learning task, and environmental factors. The implications of this research for instruction is that color use must be standardized in a lesson, and used consistently and conservatively. (9 references) (DB)

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Computer-based Education Research Laboratory
University of Illinois at Urbana-Champaign

COLOR IN COMPUTER-ASSISTED INSTRUCTION

ESTHER R. STEINBERG

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by

Esther R. Steinberg

e-mail: steinbrg@cerl.uiuc.edu

University of Illinois at Urbana-Champaign
252 Engineering Research Laboratory
103 South Mathews
Urbana, IL 61801

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Color monitors are in wide use in computer systems. Thus, it is important to understand how to apply color effectively in computer-assisted instruction (CAI) and computer-based training (CBT). Color can enhance learning, but it does not automatically do so. Indiscriminate application of color can mislead a student and thereby even interfere with learning.

Research is equivocal about the effectiveness of color in instruction, and the application of color is still more of an art than a science. Nevertheless, we do have some knowledge from research and practical experience to guide us.

This document limits discussion to the influence of color on learning and the implications for instruction, with special considerations for the application of color to CAI and CBT. Neither programming techniques nor perceptual and technical aspects of color (e.g., wave lengths) are included.

HOW COLOR ENHANCES LEARNING

Motivates

Motivation is an essential ingredient in learning. While motivation alone cannot improve learning, it certainly does help. Students of all ages, adults as well as children, prefer to receive instructional materials in color. A book with colored pictures, for example, is more attractive than one in monochrome. Similarly, color on computer display screens is more appealing than black and white.

Attracts Attention

Color can be employed to attract attention both before and after learning begins. An appropriately colored title page can gain attention and help motivate a student to study the lesson. Color can lead the eye to the starting point on a computer display screen. If new vocabulary words are introduced in a paragraph, students' attention can be gained by displaying them in a different color from the rest of the text.

Emphasizes Important Elements

Emphasis on important information can be achieved by the application of color. In text, key words can be highlighted by presenting them in a different color from the rest of the message. Of course, care must be taken not to highlight too many words with color lest color lose its significance.

Locates Information

If the nature of the materials is such that the display is cluttered, coloring critical elements (such as the location of hazardous materials) can help learners identify the location of those elements. Geometric shapes, such as rectangles, can also help viewers locate information, but color conveys the information more quickly.

Adds Structure

Explicit cues about the organization and structure of an instructional presentation are often helpful to learners. Color can indicate the structure of a display. For example, the headings and topic sentences might be presented in a different color from the rest of the text.

Supports Memory And Recall

Color can aid learning by presenting paired items that go together in the same color, such as foreign language vocabulary, or upper and lower case letters. One researcher presented students pairs of letters and asked them to classify them as same or different. Their responses were slower if the letters were different colors regardless of whether the letter was upper or lower case, or what color was used. The implication is that if you want students to remember things that go together and want to use color, put things that go together in the same color.

Differentiates Among Elements

Color can help learners differentiate among items. If several curves are displayed on a graph, a different color for each curve helps the viewer differentiate one from another. A map of the United States might show all states that lost population in the last decade in one color, those that have gained population in another, and those that have not changed in yet another color.

Ties Together Related Items That Are Scattered

Color can tie together related elements that are scattered about a display screen. If, for example, the use of past tense is scattered through a paragraph of text and the author wants to draw attention to its use, he or she can display it in a different color from the rest of the text. Viewers tie together information by color even if it is unrelated. Thus, if the same color is used for unrelated items, there may be some interference with learning.

Adds Visual Cues

Color can serve as a nonverbal visual cue to help learners identify specific elements on a computer screen. For example, directions for advancing through a lesson may always be in the same color, say white, and instruction per se in yellow. It is true that directions can also be set apart from instruction by spatial arrangement on a display, but the use of color adds redundant information which can be helpful. Caution is recommended in selecting the number of cues to be color-coded. As the number of color-coded cues increases, the value of color coding decreases.

VARIABLES THAT INTERACT WITH COLOR

Characteristics Of The Learners

Characteristics of the learners should be taken into account when using color. Younger children, say below the age of 10 years, do not make use of color as a learning cue. Color for these children is primarily a motivational attribute. Older people whose vision is failing require sharp contrast between foreground and background colors. Many people of all ages have color deficiencies and cannot discriminate between some pairs of colors.

Nature Of The Task

If the task involves remembering related items, presenting them in the same color helps retention. However, if there is no relationship among items, presenting them in the same color might interfere with learning. Students may focus on irrelevant rather than relevant relationships.

Environmental Factors

Environmental factors also interact with color. At present there is no standardization in the color supported by various computer graphics cards and monitors. Two colors may contrast well on one computer system but not on another. In addition, colors may contrast well on one system but be difficult to read on monochrome displays. Finally, brightly lit or darkened rooms affect the readability of a display.

IMPLICATIONS FOR INSTRUCTION

Plan Standard Use of Color

Decide on a standard use of color for specific aspects of your lesson. For example, the standard colors you choose may be a black background and cyan foreground for instruction. Directions are presented in white, page and topic headings in yellow. Perhaps emphasis on words is accomplished with green.

By standarizing colors you are providing the viewers with a visual cue in addition to a verbal one. One author recommends designing in monochrome first and then adding color.

Be Consistent

A good way to support the notion of color as a visual cue is to be consistent. Use the same color for the same purpose throughout a lesson. If directions are given in yellow one time, magenta another, and green a third, color no longer serves as a visual cue. It may even be annoying.

Be Conservative

There is no consensus on the number of colors you should choose. Generally speaking, use no more than four or five colors colors on a single display. Of course, sometimes the information being presented requires more colors.

Check Diverse Monitors

Select basic colors that make the presentation stand out well against the background. This may require some investigation because the appearance of color to the eye varies from one computer monitor to another. In addition, some color combinations do not show up well on monochrome screens. Although color is widely available, if you are not sure that all of your intended users will have color monitors, you need to check your lesson on monochrome screens, too.

Use Color As A Redundant Cue

It was noted earlier that some people are color deficient. Therefore color should be used as a redundant cue. Road signs are an example of the use of color as a redundant cue. Each sign has a unique shape and color. They have even one more redundant cue - a verbal message or graphic symbols.

FURTHER COMMENTS

No study has yet demonstrated that any one color is easier on the eyes for reading text than any other. Any color should be acceptable as long as there is sufficient contrast with the background.

There is no evidence that color in general or that the use of many colors will result in visual fatigue, but if colors are used unwisely, performance may not be as good as desired.

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